Sampling Episode Report
Holland America Veendam
Sampling Episode 6503

Chapter 3
Sample Collection Methodology

March 2006

3.0 SAMPLE COLLECTION AND ANALYSIS METHODOLOGY

This section describes the sample collection and analysis methods and deviations from the ship-specific Sampling and Analysis Plan for Holland America Veendam (Veendam SAP; Appendix E). A more detailed explanation of the sampling methodologies, analytes and analytical methods, sampling frequency and duration, schedule, and logistics that were followed during sampling onboard the Veendam can be found in Section 3.0 of the Veendam SAP.

3.1 Pre-Sampling Activities

EPA performed an engineering ship visit to the Veednam on March 27, 2004. The Veendam SAP was prepared based on information collected during that ship visit and from subsequent follow-up communication with Holland America personnel. One week prior to the sampling episode, personnel conducted sampling setup activities onboard the Veendam, including loading sampling equipment and the onboard laboratory, inspecting the installed sampling ports, installing the strap-on ultrasonic flow meters, and installing and programming the automatic sampling machines.

3.2 Sample Collection and Analysis Methodology

In general, graywater sources and wastewater treatment residual samples were taken for one 24-hour period, while samples of the influent to and effluent from the treatment system were taken for five consecutive 24-hour periods (see Tables 2-1 and 2-2). Various sample collection methods (described in Table 3-1) were used depending on the waste stream and analyte (see Table 3-2). Most samples were composited over each 24-hour sampling period or were single grab samples in a 24-hour period. However, multiple (1 to 4) grab samples per 24-hour period were collected for pathogen indicator analyses because these samples must be analyzed within 6 hours of collection (see Table 3-2). Table 3-3 describes the analyte groups and lists the analytical methods used.

Each time a grab or grab composite sample was taken, another separate sample was placed in a separate container to perform field measurements of pH, temperature, conductivity, salinity, turbidity, sulfide, and free and total chlorine on board. Temperature and pH were measured immediately at the sampling point, and the remaining parameters were measured at the sample staging area on board. See Table 3-4 for equipment used for these measurements. Field measurements are used primarily to determine sample preservation requirements. Samples (other than those used for field measurements) were preserved in accordance with procedures described in the Veendam SAP (Appendix E), with exceptions as noted in Section 3.6 and Table 3-5. Note that while Alaska and Federal regulations for cruise ship discharges include standards for total residual chlorine, the equipment used to measure residual chlorine onboard was not suitable for measuring low levels of chlorine (detection limit of 20 µg/L compared to a standard of 10 µg/L) and was subject to various interferences, such as from oxidized forms of manganese. Accordingly, the field measurements collected during this sampling episode should not be used to assess compliance with cruise ship discharge standards.

Flow data were collected from both the strap-on flow meters installed by the sampling team and the pre-existing Veendam in-line flow meters. See Section 2.4 for descriptions of the flow meter locations and Figures 2-1 and 2-2 for their locations. The strap-on flow meters were programmed to record the instantaneous flow rate (m^3/min) and total cumulative flow (m^3) every five minutes. Total cumulative flow (m^3) from the in-line flow meters was manually recorded approximately every four hours during the sampling episode.

3.3 Converting Solids Mass Units to Volume Units

The food pulper, screening solids, and waste biosludge samples had high solids contents; therefore, the results listed below were reported by the laboratories in mass units.

- Food pulper: volatile and semivolatile organics;
- Screening solids: classical pollutants (except total and available cyanide), total mercury, and volatile and semivolatile organics; and

- Waste biosludge: classical pollutants (except total and available cyanide), total mercury, and volatile and semivolatile organics.

Solids contents for these samples ranged from 1.3% to 2.9%. To allow for direct comparison of these results to those of other wastewater samples, mass units for these samples were converted to volume units using the following equation and assuming a sample density of 1:

Amount (mass units) * (% solids/100) = Amount (volume units)

All data in this report pertaining to food pulper, screening solids, and waste biosludge samples are reported in volume units. The laboratory data packages, which are included in the Cruise Ship Rulemaking Record and available upon request, contain the original mass units results reported by the laboratories. Note that the analytical results for the incinerator ash sample were also reported in mass units. However, the incinerator ash results were not converted because the sample was 97.1% solids.

3.4 Quality Assurance/Quality Control

Duplicate samples were collected for quality assurance and quality control. Results for duplicate samples were averaged. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling. Other field quality control samples prepared for this sampling episode include a trip blank and an equipment blank, which are discussed in Sections 5.2.1 and 5.2.2, respectively.

3.5 Interview with the Ship's Crew

The ship's crew was interviewed to obtain information regarding activities that impact wastewater generation. See Appendix C for details on these interviews and Section 4.2 for a summary.

3.6 Deviations from the Sampling and Analysis Plan

The sampling episode proceeded as specified in the Veendam SAP with the deviations described in Table 3-5.

Table 3-1

Sample Collection Method Descriptions, Holland America Veendam

Sample Collection Method	Description
Composite by Flow	Flow-weighted composite samples were collected using an automatic sampling machine interfaced with an installed strap-on ultrasonic flow meter (see Section 2.4). The flow meter signaled the automatic sampling machine to collect a 250-mL sample aliquot each time a fixed quantity of wastewater passed through the wastewater pipe. The number of composite sample aliquots collected per 24-hour sampling period ranged from approximately 75 to 150, depending on the total volume of sample required for planned analyses each sampling day. Sample aliquots were collected into a 10-L sample composite jar stored within the sampling machine. At the end of each 24-hour sampling period, the sample composite jar(s) were mixed and poured into individual sample bottles for analysis. Samples collected using the composite-by-flow method best represent a waste stream flowing through a pipe.
Composite by Time	Time-weighted composite samples were collected using an automatic sampling machine programmed to collect 250-mL sample aliquots at fixed time intervals. The programmed time interval differed by sampling point (see Table 3-2). The number of composite sample aliquots collected per 24-hour sampling period ranged from approximately 75 to 150, depending on the total volume of sample required for planned analyses. Sample aliquots were collected into a 10-L sample composite jar stored within the sampling machine. At the end of the 24-hour sampling period, the sample composite jar(s) were mixed and poured into individual sample bottles for analysis. The composite-by-time method was used when the composite-by-flow method was not feasible.
Grab	Grab samples were discrete samples collected directly into the sample bottles from the sample tap or through Teflon® tubing connected to the sample tap. Note that samples for pathogen indicator analyses were collected as grab samples (as opposed to composite samples) because they must be analyzed within a 6-hour holding time.
Grab Composite	Samples (1 to 4 per 24-hour sampling period) were manually collected as grab samples but composited either in the field or at the laboratory for a single analysis. The grab composite method was used when the composite-by-flow or composite-by-time methods were not appropriate. **Volatile organics** - grab samples were collected directly into sample vials, which were filled completely to avoid loss of target analytes by volatilization. Grab samples for each 24-hour period for analysis of volatile organics were composited by the laboratory for a single analysis. **Total and available cyanide** - grab samples were chemically preserved as soon as possible to minimize sample interferences. The preserved total and available cyanide grab samples for each 24-hour period were composited onboard by the sampling team for a single analysis. **Hexane extractable material/silica-gel treated hexane extractable material (HEM/SGT-HEM)** - grab samples were collected directly into sample containers to avoid loss of HEM/SGT-HEM that might adhere to the interior of any interim sampling container (e.g., sample composite jar). See Table 3-5, HEM/SGT-HEM sample collection, for a description of the HEM/SGT-HEM grab composite sampling method, resulting in a single analysis for each 24-hour sampling period.

Table 3-2

Sample Collection Methods and Analyte Groups Tested by Sampling Point, Holland America Veendam

Wastewater Name	Sampling Point #(a)(b)	Sample Collection Methods (c)	Analyte Groups Tested (d)	# of Days Sampled
Laundry	SP-1/2	**Composite by time** Automatic sampling machine was programmed to collect 250-mL sample aliquots at three-minute time intervals. The sampling machine successfully collected sample aliquots only during the relatively few intervals during the 24-hour sampling period (2300 on 6/23/04 to 2300 on 6/24/04) when the laundry wastewater was generated and flowed through the inlet pipe to the holding tank, thereby more closely approximating a flow-weighted composite sample.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II Total and dissolved metals Semivolatile organics Dioxins and furans	1 (Day 4)
		Grab composite Collection times of the four subsamples in the composite can be found in Appendix A-3.	Classical pollutants: - HEM/SGT-HEM - Total and available cyanide Volatile organics	
		Grab One grab sample was taken. Appendix A-1 shows the collection time.	Pathogen indicators	
Accommodations	SP-3	**Composite by time** Automatic sampling machine was programmed to collect 250-mL sample aliquots at three-minute time intervals. The sampling machine successfully collected sample aliquots only during the relatively few intervals during the 24-hour sampling period (0600 on 6/23/04 to 0600 on 6/24/04) when the accommodations wastewater holding tank discharge pump turned on, thereby more closely approximating a flow-weighted composite sample.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II Total and dissolved metals Semivolatile organics	1 (Day 4)
		Grab One grab sample was taken. Appendix A-1 shows the collection time.	Pathogen indicators Classical pollutants: - HEM/SGT-HEM - Total and available cyanide Volatile organics	

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Veendam graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.
(e) Source water samples for pathogen indicator analyses were collected for five days. Source water samples for analysis of all other analytes were collected for one day (Day 1).

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a)(b)	Sample Collection Methods (c)	Analyte Groups Tested (d)	# of Days Sampled
Food Pulper	SP-4	**Grab composite** To characterize the food pulper wastewater that is conveyed to the wastewater treatment system, grab samples were collected from the tank just prior to discharging the food pulper wastewater holding tank to the wastewater treatment system (i.e., just prior to 0800, 1500, and 2000). See Appendix A-3 for the exact collection times for the three subsamples in the composite.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II - HEM/SGT-HEM - Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	1 (Day 3)
		Grab Grab food pulper samples were collected from the same location as described above. Two grab samples were taken. Results presented in Table 4-1 are an average. Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	
Galley	SP-5	**Composite by time** Automatic sampling machine was programmed to collect sample aliquots at 20-minute time intervals during the 24-hour sampling period (1200 on 6/21/04 to 1200 on 6/22/04).	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II Total and dissolved metals Semivolatile organics Pesticides	1 (Day 2)
		Grab composite Collection times of the four subsamples in the composite can be found in Appendix A-3.	Classical pollutants: - HEM/SGT-HEM - Total and available cyanide Volatile organics	
		Grab One grab sample was taken. Appendix A-1 shows the collection time.	Pathogen indicators	

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Veendam graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.
(e) Source water samples for pathogen indicator analyses were collected for five days. Source water samples for analysis of all other analytes were collected for one day (Day 1).

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a)(b)	Sample Collection Methods (c)	Analyte Groups Tested (d)	# of Days Sampled
Influent to Zenon Treatment System	SP-6/7	**Composite by Flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II Total and dissolved metals Semivolatile organics Pesticides Polychlorinated biphenyls	5
		Grab Composite The collection times of the four subsamples in the composites each day can be found in Appendix A-3.	Classical pollutants: - HEM/SGT-HEM - Total and available cyanide Volatile organics	
		Grab The number of grab samples taken per sampling day were as follows: 4, 3, 2, 3, 3. Results presented in Table 4-2 are an average for each sampling day. Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	
Influent to UV Disinfection part of Zenon Treatment System	SP-8	**Grab** The number of grab samples taken per sampling day were as follows: 4, 3, 2, 3, 3. Results presented in Table 4-3 are an average for each sampling day (calculation used detection limits for nondetected results). Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	5

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Veendam graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.
(e) Source water samples for pathogen indicator analyses were collected for five days. Source water samples for analysis of all other analytes were collected for one day (Day 1).

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a)(b)	Sample Collection Methods (c)	Analyte Groups Tested (d)	# of Days Sampled
Effluent from Zenon Treatment System	SP-9/10	**Composite by Flow** Twenty-four-hour sampling periods began at 0600 each day.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II Total and dissolved metals Semivolatile organics	5
		Grab Composite Collection times of the four subsamples in the composites each day can be found in Appendix A-3.	Classical pollutants: - HEM/SGT-HEM - Total and available cyanide Volatile organics	
		Grab The number of grab samples taken per sampling day were as follows: 4, 3, 2, 3, 3. Results presented in Table 4-4 are an average for each sampling day (calculation used detection limits for nondetected results). Results and collection times for each grab sample are presented in Appendix A-1.	Pathogen indicators	
Screening Solids	SP-11	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II - Total and available cyanide Total metals Volatile and semivolatile organics	1 (Day 1)
Waste Biosludge	SP-12	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II - Total and available cyanide Total metals Volatile and semivolatile organics	1 (Day 2)

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Veendam graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.
(e) Source water samples for pathogen indicator analyses were collected for five days. Source water samples for analysis of all other analytes were collected for one day (Day 1).

Table 3-2 (Continued)

Wastewater Name	Sampling Point #(a)(b)	Sample Collection Methods (c)	Analyte Groups Tested (d)	# of Days Sampled
Incinerator Ash	SP-13/14	**Grab** One grab sample was taken. Appendix A-3 shows the collection time.	Total metals Semivolatile organics Dioxins and furans	1 (Day 1)
Source Water	SP-15	**Grab** One grab sample was taken per sampling day for pathogen indicator analyses, while one grab sample was taken for all other analytes. Appendix A-3 shows the collection times.	Pathogen indicators Classical pollutants: - BOD_5 - Settleable residue - Group I - Group II - Total and available cyanide Total and dissolved metals Volatile and semivolatile organics	5 / 1 (e)
Trip Blank	SP-16	**Grab** One grab sample was taken. High performance liquid chromatography (HPLC) water was poured directly into sample vials in the contractor's Chantilly, VA sampling room and shipped to the Veendam. The trip blank was shipped back (unopened) to the laboratory along with the collected samples.	Volatile organics	1
Equipment Blank	SP-17	**Grab** One grab sample was taken. The equipment blank consisted of HPLC water pumped through the automatic sampling machine and tubing and directly into sample bottles.	Total and dissolved metals Semivolatile organics	1

(a) See Figures 2-1 and 2-2 for simplified diagrams of the Veendam graywater and sewage CHT and treatment systems indicating the sampling point and flow meter locations.
(b) Two sampling point numbers indicate duplicate samples taken at this point for certain analytes. See Section 5.2.3 and Tables 5-3 and 5-4 for details on duplicate sampling.
(c) See Table 3-1 for descriptions of sample collection methods.
(d) See Table 3-3 for additional information regarding analytes tested and analytical methods used.
(e) Source water samples for pathogen indicator analyses were collected for five days. Source water samples for analysis of all other analytes were collected for one day (Day 1).

Table 3-3

Analytes and Analytical Methods, Holland America Veendam

Analyte Group	Analytes	Analytical Method Number
Pathogen Indicators	*E. Coli*	EPA 9223B
	Enterococci	ASTM D6503-99
	Fecal Coliform	EPA 9222D
Classical Pollutants	Biochemical Oxygen Demand (BOD_5)	EPA 405.1
	Settleable residue (SS)	EPA 160.5
	Group I: - Total Suspended Solids (TSS) - Total Dissolved Solids (TDS) - Sulfate - Chloride - Alkalinity	 EPA 160.2 EPA 160.1 EPA 375.4 EPA 325.3 EPA 310.1
	Group II: - Total Organic Carbon (TOC) - Chemical Oxygen Demand (COD) - Ammonia as Nitrogen - Nitrate/Nitrite as Nitrogen - Total Kjeldahl Nitrogen (TKN) - Total Phosphorus	 EPA 415.1 HACH 8000 EPA 350.1 EPA 353.2, EPA 1685 (“solids” samples) EPA 351.3, EPA 1687 (“solids” samples) EPA 365.1
	Oil and grease measured as hexane extractable material and petroleum hydrocarbons measured as silica-gel treated hexane extractable material (HEM/SGT-HEM)	EPA 1664
	Cyanide - Total cyanide - Available cyanide	 EPA 335.3 EPA 1677
	Hardness	SM 2340B
Total and Dissolved Metals	See Appendix A-2 for complete list of total and dissolved metals analyzed.	EPA 200.7, EPA 200.8 (selenium and thallium), EPA 245.1 (mercury, “liquid” samples), EPA 245.5 (mercury, “solids” samples)
Volatile and Semivolatile Organics	See Appendix A-2 for complete list of volatile and semivolatile organics analyzed.	EPA 624 EPA 625
Pesticides	See Appendix A-2 for complete list of organohalide and organophosphorus pesticides analyzed.	EPA 1656A EPA 1657A
Polychlorinated Biphenyls (PCBs)	See Appendix A-2 for complete list of PCBs analyzed.	EPA 1668A
Dioxins and Furans	See Appendix A-2 for complete list of dioxins and furans analyzed.	EPA 1613B

Table 3-4

Field Measurement Equipment, Holland America Veendam

Parameter	Measured by:
pH	Four-color pH paper
Temperature	Alcohol thermometer
Conductivity and Salinity	Portable conductivity/salinity meter (YSI Model 30)
Turbidity	Pocket turbidimeter (Hach Cat. No. 52600-00)
Sulfide	Colorimeter (Hach DR 890)
Free and Total Chlorine	Pocket colorimeter (Hach Cat. No. 46700-00)

Table 3-5

Deviations from the Sampling and Analysis Plan, Holland America Veendam

Deviation	Description
Pathogen Indicators Sample Collection	The number of grab samples collected for pathogen indicator analyses was reduced from 97 described in Table 3-1 of the Veendam SAP to 66 (including QC samples), primarily due to capacity limitations of the onboard laboratory. The actual number of pathogen indicators samples analyzed is indicated in the presentation of analytical results in Section 4.1 and in Appendix A-1 of this document. The sampling team collected and analyzed as many pathogen indicators samples as was feasible, with an emphasis on wastewater treatment samples. Although diminished, the resulting pathogen indicators data set is adequate for EPA's needs for this program.
Pathogen Indicators Laboratory Duplicates	For 5% of the pathogen indicators samples, duplicate 100-mL sample volumes were taken with the intention that the laboratory would composite the 100-mL sample volumes and then analyze duplicate samples from each composite sample to evaluate laboratory precision (i.e., laboratory duplicates). However, the laboratory did not prepare composites, but instead analyzed each of the 100-mL sample volumes individually. Accordingly, the results obtained from these analyses are field duplicate samples, not laboratory duplicates, and are presented and handled as such in this report. See Section 5.2.3 and Table 5-4 for details on duplicate sampling for pathogen indicators.
Pathogen Indicators Field Duplicate Samples	The sampling team planned to collect field duplicate samples for pathogen indicators at only the effluent from treatment (SP-9/10). However, the laboratory mistakenly analyzed additional pathogen indicators sample volume that was collected as a contingency at the influent to treatment (SP-6/7) and the influent to UV disinfection (SP-8). Contingency sample volume was collected using the same methodology as the original sample. Accordingly, the results obtained from these analyses are field duplicates and are presented and handled as such in this report. The duplicate sample pairs include samples 65224/65310 and 65259/65304. See Section 5.2.3 and Table 5-4 for details on duplicate sampling for pathogen indicators.
HEM/SGT-HEM Sample Collection	HEM/SGT-HEM grab samples were not analyzed separately at the laboratory. Instead, the sampling team developed a methodology to composite the HEM/SGT-HEM grab samples onboard for a single analysis per sampling point per day, rather than up to 4 separate sample analyses per sampling point per day. For example, at sampling points where a total of four grab samples were collected during a 24-hour sampling period, the sampling team filled approximately one-fourth (250 mL) of the sample containers when they collected each grab sample, resulting in 1-liter of sample in each container at the end of each sampling period. This deviation significantly reduced sample handling and storage requirements, which were limited onboard the ship, while still producing a HEM/SGT-HEM data set adequate for EPA's needs for this program.
HEM/SGT-HEM Field Duplicate Samples	Field duplicate samples for HEM/SGT-HEM analysis were not planned. However, due to sampler error on the sample bottle labels, the laboratory mistakenly analyzed additional HEM/SGT-HEM sample volume that was collected as a contingency at certain sampling points/days. Contingency sample volume was collected using the same methodology as the original sample. Accordingly, the results obtained from these analyses are field duplicates and are presented and handled as such in this report. The duplicate sample pairs include samples 65227/65228, 65231/65232, 65269/65270, 65273/65274, and 65277/65278. See Section 5.2.3 and Table 5-4 for details on duplicate sampling for HEM/SGT-HEM.
Hardness	The method was revised to determine hardness from a field titration measurement to a calculation determined using metals analysis results for calcium and magnesium. The calculation approach is considered to be more accurate than the field titration approach (see Method 2340B in *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998).

Table 3-5 (Continued)

Deviation	Description
Laundry Wastewater (SP-1/2)	The sampling team was unable to integrate the strap-on flow meter with the automatic sampling machine to collect a flow-weighted composite sample at this sampling point. Although the sampling set-up team was able to successfully install a strap-on flow meter at the discharge from the laundry wastewater holding tank, the sampling tap was not installed at this same position due to commingling of other graywater sources caused by backflow from the graywater main common line. (Note: the flow meter was set to ignore negative flow through the pipe.) Instead, the ship's crew installed the sampling tap on the gravity drain inlet pipe to the laundry wastewater holding tank. The strap-on flow meter could not be used to initiate collection of flow-weighted composite samples because flow measurements at the discharge pipe consistently triggered sample collection when no wastewater was flowing in the inlet pipe. As an alternative sampling methodology, the automatic sampling machine was programmed to collect a time-weighted composite sample as described in Table 3-2. EPA concluded that the collected samples were representative of laundry wastewater as generated onboard the Veendam.
Accommodations Wastewater (SP-3), Composite Samples	The strap-on flow meter set-up and calibration procedure was unsuccessful at the accommodations wastewater sampling point (the outlet pipe from the accommodations wastewater holding tank), most likely due to poor pipe flow conditions such as pipe scaling or extreme aeration. As a result, flow data could not be collected at this sampling point. In addition, the flow meter could not be used to initiate collection of flow-weighted composite samples at SP-3 as described in the Veendam SAP. As an alternative sampling methodology, the automatic sampling machine was programmed to collect a time-weighted composite sample as described in Table 3-2. EPA concluded that the collected samples were representative of accommodations wastewater as generated onboard the Veendam.
Accommodations Wastewater (SP-3), Grab Samples	The sampling team successfully collected only one of the four planned grab samples at SP-3 due to the inability to coordinate sample collection times with adequate wastewater volumes in the accommodations holding tank. After collecting the first sample, samplers unsuccessfully attempted to collect grab samples by manually operating the duty pump approximately once per hour throughout the 24-hour sampling period. EPA concluded that the single grab sample represented an instantaneous snapshot of accommodations wastewater as generated onboard the Veendam.
Effluent From Treatment (SP-9/10)	The sampling team was unable to use the input/output on the existing flow meter at SP-9/SP-10 to collect flow-weighted composite samples at this sampling point because it would modify existing flow meter outputs. As an alternative sampling methodology, the sampling team installed a strap-on flow meter at this location to collect flow characterization data and to control automatic composite sample collection. Comparison of the instantaneous flow measurements for the existing and strap-on flow meters throughout the sampling episode demonstrated excellent agreement. This deviation had no impact on the representativeness of the collected samples. Composite by flow sampling at SP-9/SP-10 was suspended on Day 3 from 0645 to 2120 because overboard discharge was restricted while the ship cruised Glacier Bay. (The flow meter that controlled composite by flow sample collection was located on the overboard discharge pipe, but during this time the effluent was diverted to double-bottom holding tanks.) However, grab and grab composite samples were taken during this period.
Waste Biosludge (SP-12)	The sampling team was unable to collect waste biosludge samples during overboard discharge because of the inability to install a functional sample tap on the vertical gravity flow discharge piping. As an alternative sampling methodology, the sampling team collected a one-time grab sample of waste biosludge before it was sent to and held in the double-bottom holding tank for eventual discharge 12 nm from shore. Accordingly, the collected samples characterize waste biosludge as generated rather than as discharged.

Table 3-5 (Continued)

Deviation	Description
Cyanide Sample Preservation	The supply of lead carbonate preservative was consumed after the second sampling day. Therefore, for sampling Days 3 through 5, samples were not treated to remove sulfide prior to receipt by the laboratory. See the memorandum *Issues Associated with Results for Total Cyanide Versus Available Cyanide*, included in Appendix D, for further information regarding the impact of sulfide interferences on cyanide results.
Volatile Organics Preservation	Free chlorine was detected in presampling field tests at all sampling points. Based on these results, the sampling team prepreserved all volatile organics sample vials with sodium thiosulfate rather than waiting to determine preservation requirements based on the free chlorine field test results. Free chlorine was generally detected in grab samples collected throughout the sampling episode. (Sample vials were also prepreserved with hydrochloric acid to control biological activity as discussed in the Veendam SAP.)
Analytical Methods	EPA-contracted laboratories substituted comparable approved EPA analytical methods for analysis of certain analytes. Table 3-3 lists the actual analytical methods used by the laboratories. Note that while the Veendam SAP correctly listed EPA Methods 624 and 625 as the planned methods for analyzing volatile and semivolatile organics, respectively, Appendix E of the Veendam SAP mistakenly listed the target analytes for EPA Methods 1624 and 1625. Appendix A-2 of this report presents the actual list of target volatile and semivolatile organics.
Sampling Schedule	The sampling team adjusted the sampling schedule in Appendix C of the Veendam SAP to accommodate sampling logistics and ship operations. Refer to Appendix A-3 of this report for actual samples collected and sample collection dates/times.
Ship Overview Inaccuracies	Certain information in Section 3.0, Ship Overview, of the Veendam SAP, was inaccurate or incomplete: • *Food pulper wastewater.* Food pulper wastewater is not pretreated by grease traps but conveyed to the treatment system without pretreatment. • *Wastewater treatment chemical addition.* Operators add defoamer (rarely) and caustic to the bioreactor as needed; nitrogen (nutrient) addition is no longer used and has been disabled. Operators add citric acid and sodium hypochlorite to the membrane backwash tank on alternate days. • *Ultrafiltration membrane cleaning cycle.* See Section 2.2 of this report for a description of the membrane cleaning cycle. • *Wastewater treatment residuals.* See Section 2.2 of this report for additional information regarding wastewater treatment sludge generation, handling, and discharge/disposal.